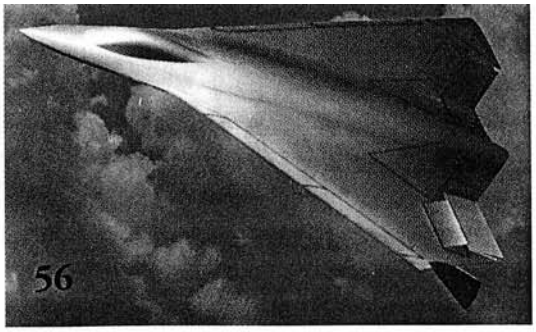


High-Altitude Drone Gets to Work On ARM-UAV Program

MICHAEL A. DORNHEIM/LOS ANGELES

The General Atomics Altus high-altitude drone recently completed a several-week atmospheric science campaign, demonstrating its ability to conduct long-endurance missions in coordination with spacecraft, ground sensors and another aircraft.

The Altus flew as part of the Energy Dept.'s Atmospheric Radiation Measurement-Unmanned Aerospace Vehicle (ARM-UAV) program, which measures how solar energy is absorbed and radiated by clouds and other atmospheric phenomena (*AW&ST* Feb. 10, 1992, p. 50). On Oct. 4-5, it made a 26-hr., 11-min. flight for continuous measurement of a day-night-day cycle, eliminating instrument calibration concerns that would have arisen from using several shorter endurance aircraft. Sandia National Laboratory is the ARM-UAV technical director.

THE ALTUS IS A MODIFIED version of General Atomics' Predator reconnaissance drone. It has a longer 55-ft. wingspan and a Rotax 914 liquid-cooled piston engine with a custom single-stage turbocharger producing 110 hp. to 23,000 ft. (*AW&ST* July 10, 1995, p. 50). Takeoff weight for the 26-hr. flight was 2,150 lb., which included 514 lb. of gasoline. While Altus has reached 35,000 ft. in the ARM-UAV program, it operated at 20,000-22,000 ft. for the endurance flight. It landed with 130 lb., or 8-10 hr. of fuel remaining.

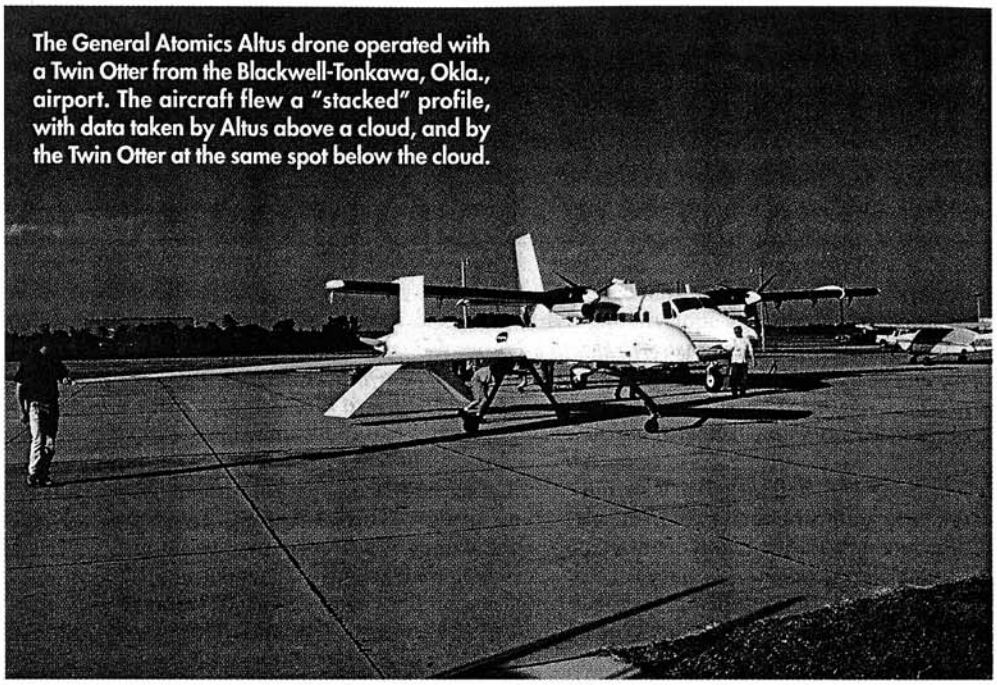
The Altus carries a 370-lb. payload consisting of seven instrument types:

- A visible and near-infrared sensor with hemispherical coverage.
- A hemispherical infrared sensor operating in the 4-20 micron band.
- A total direct-diffuse radiometer (TDDR), which uses a rotating Sun shade to alternately view direct and diffuse solar energy. The radiometer operates in the visible and near-infrared band.
- Pressure altitude, total temperature and water vapor probes provided by Sandia.
- A multispectral pushbroom imaging ra-

diometer (MPIR) provided by Sandia, with nine spectral bands that can be changed to match those used in satellites. The device uses a "pushbroom" scanning linear array.

- A cloud-detecting laser radar provided by Lawrence Livermore National Laboratory, to measure the environment of clouds and particulates around the drone.
- A seanning spectral polarimeter (SSP) provided by Colorado State Univ. to characterize clouds. The instrument has about 80 spectral bins and experimenters hope to extend the observed wavelength to a 4-40 micron band.

The first three instruments were provided by the Atmospheric Sciences Branch of the Scripps Institute of Oceanography and have apertures that look both up and down. The latter three instruments are down-looking in Altus.



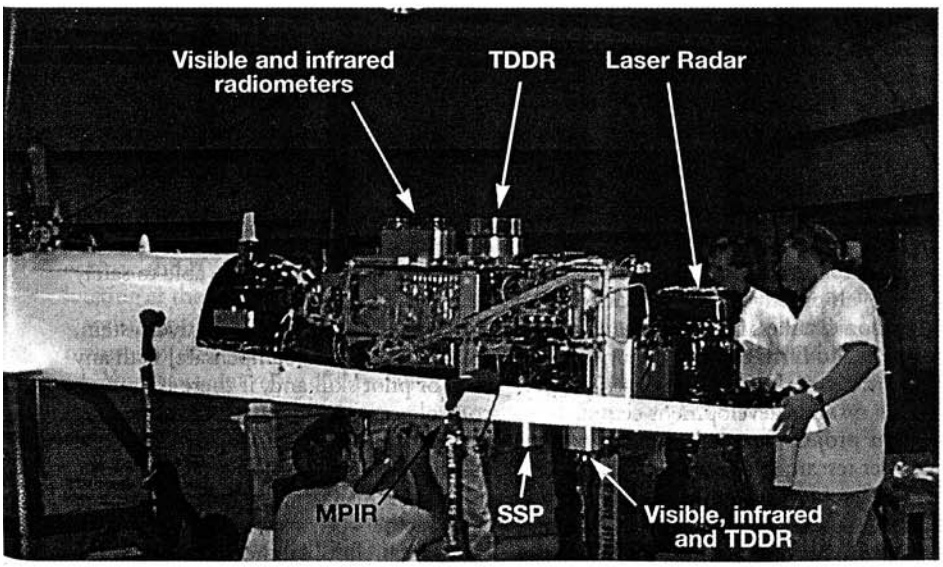
The General Atomics Altus drone operated with a Twin Otter from the Blackwell-Tonkawa, Okla., airport. The aircraft flew a "stacked" profile, with data taken by Altus above a cloud, and by the Twin Otter at the same spot below the cloud.

ON SEVERAL MISSIONS, an instrumented de Havilland DHC-6 Twin Otter would fly underneath clouds at 2,500-17,000 ft. while the Altus was directly overhead above the clouds at 20,000-35,000 ft. for good correlated data. "We want the instruments to measure the same part of the same cloud," a Sandia official said. The Altus was the lead aircraft and was flying from waypoint to waypoint in a heading command mode. It would transmit its GPS position to a display in the Twin Otter, whose pilots were often able to stay within 1,000 ft. of the Altus nadir. The Altus ground speed ranged from 60-135 kt.

The Twin Otter also escorted the Altus up to the 18,000-ft. floor of Class A airspace, where the Kansas City en route traffic control center allowed the drone to operate solo. Sensor comparisons would be made between aircraft when the Twin Otter escorted Altus down from 18,000 ft.

The missions operated out of the Blackwell-Tonkawa general aviation airport west of Ponca City, Okla., and stayed within a 20-naut. mi. radius. The Energy Dept. maintains the cloud and radiation testbed (CART) network of ground sensors there, which provided further data.

The Altus was also flown in precisely-timed positions and headings to match the views from the NOAA-12 and GOES-8 satellites. NASA Langley Research Center is using MPIR data to calibrate the satellite sensors. The drone pilots were able to position Altus within "tens of seconds and hundreds of meters" to match the satellite imagery, the Sandia official said.



The Altus payload bay carries 370 lb. of instruments to measure atmospheric radiation balance.

The ARM-AUV fall campaign began in mid-September and ended with the Oct. 4-5 endurance flight. It involved 25-30 people operating Altus and the Twin Otter, and cost $1.5-2 million. The main funding source was the Defense Dept.'s Strategic Environmental Research & Development Program. After the resulting data are studied by the scientific community, plans are to be formulated for a fall, 1997, return to the CART site. Scientists also want to fly near Pt. Barrow, Alaska, and Manus Island north of Papua, New Guinea, to measure other environments, though this is not funded. "UAVs are good for long endurance and remote areas where you don't want to put a human pilot at risk," the Sandia official said.

ARM-UAV HAS JOINED with Office of Naval Research drone efforts in a program called the Center for Interdisciplinary Remotely-Piloted Aircraft Studies (CIRPAS). The Altus lease payments went to General Atomics via CIRPAS. The aircraft used was serial No. 1—loaned from NASA's "ERAST" program since the No. 2 aircraft intended for ARM-UAV was not ready.

The Energy Dept. had earlier planned to also use an Aurora Flight Sciences Perseus B drone for high altitude measurements, but the aircraft was not ready in time (*AW&ST* July 10, 1995, p. 52). Instead, a Grob G-520 Egrett manned high-altitude aircraft flown by Aurora to carry sensors in 1995 was used. "It's unlikely that we would go back to the Perseus B," the Sandia official said.